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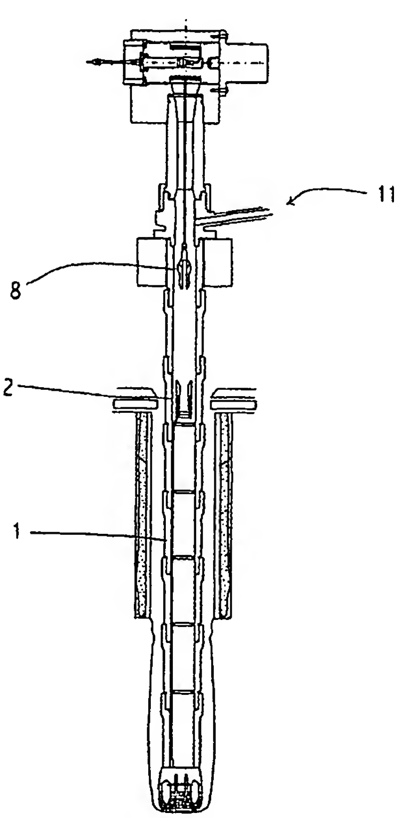
(54) Title: TELEMETERING SYSTEM



(57) Abstract: A pipe installation system, the pipe string being composed of pipe sections which are added and removed to increase and decrease the length of the drillpipe, and a length of cable is disposed within the drillpipe string and attached thereto by anchoring means. The anchoring means are deployable with the cable means and may be provided by a magnetic attraction or suction or the like between the anchoring means and he wall of the pipe, and means of removal of the cable and the anchoring means.

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Telemetering System

The present invention relates to a telemetering system, in particular, one disposed in a drillpipe.

The conventional manner of drilling a borehole comprises lowering a drill bit into the earth, the drill bit being powered, for instance, by the rotation of the drillpipe, or by fluids circulating through the drillpipe and thence back up to the surface through the space between the drillpipe and the borehole. The drillpipe is made up of sections, new sections being added periodically at the top of the drillpipe string to allow the drill bit to be lowered further.

Much useful data can be garnered from sensors included in the drillpipe, such as temperature and pressure. To retrieve this information at the surface requires some form of media to transmit it through. Known systems include using pressure waves through the circulating mud, and electromagnetic pulses. Better rates of transfer and less attenuation may be achieved however by using an electrical conducting element.

The simplest way of installing a conducting cable, or indeed any line, along the drillpipe string is to wait until drilling has ceased and lower a single length down the drillpipe string. Where it necessary to take readings from instrumentation means before the drillpipe is completed however, the cable must be lowered into the drillpipe string, only to be withdrawn each time a new drillpipe section is added to the drillpipe string.

One known method comprises a drillpipe incorporating conducting elements. The conducting elements of adjoining sections of drillpipe are

electrically connected by sliding contacts, Such a system is expensive, and liable to develop faults as a result of fluid contaminating the connection. Many telemetry systems rely upon a segmented cable running through the drillpipe, cable sections being added in order to allow fresh sections of drillpipe to be added.

Every connection between individual lengths of cable provides a further opportunity for faults to occur.

The object of the present invention is to provide an apparatus and method for disposing reliable telemetric equipment in drillpipes and the like in an efficient manner.

According to the present invention there is provide a pipe installation system, the pipe string being composed of pipe sections which are added and removed to increase and decrease the length of the pipe, wherein a length of cable is disposed within the pipe string, there being a cable storage means for stowing the cable in a compact manner and paying out the cable when the length of the pipe is increased such that the paid out cable is deployed in the increased length of pipe, wherein the anchoring means are provided which serve to attach the cable to an inside wall of the pipe following deployment of the cable in the pipe.

Preferably the anchors are attached to the cable at pore-determined positions a long the length of the cable. Preferably the anchors position themselves in an anchoring position as the cable is paid out. Preferably the anchors consist of a ring shaped wire which correspond approximately to the inside diameter of the pipe.

Alternatively the anchoring means may be provided by the cable being magnetic and attaching itself to the inside wall of the pipe magnetically. Preferably the cable includes a sheath of effectively permanently magnetisable material, such as steel, the sheath being magnetised shortly before deployment. Alternatively the magnetic attractiveness could be provided by a magnetic flexible tape attached to the conductor or a complete outer layer. The anchoring means could also be provided by suction means.

Alternatively the anchoring means may be provided by the inside wall of the pipe and activated as the spool passes through the pipe.

Preferably the spool includes a cable feeder which guides the cable to the desired position inside the pipe. Preferably this is against the inside wall of the pipe.

Preferably the cable store means is a bobbin upon which the cable is wound. The cable may include a wireless transmitter capable of transmitting signals to a signal receiver. The cable is preferably releasably connected to a connector at its top, the cable being disconnected from the connector when a pipe section is to be added or removed, threaded through the pipe section before being reconnected to the connector, the cable including a wireless transmitter, such that signals carried by the cable can be transmitted by the wireless transmitter to be received by a signal receiving means.

According to a further aspect of the present invention, there is provided a method of removing a cable installed along a pipe string or the like, and fixed to the inside wall thereof by anchoring means, the pipe string being composed of pipe sections which are removed as the removal of the

pipe string progresses, a length of cable being disposed within the pipe string, a cable removing means being releasably connected to a connector at its top, the cable removing means being adapted to remove the cable and the cable anchors.

The cable removal means preferably includes means for applying a solvent to dissolve part of the cable or its anchoring means.

A telemetering system will now be described, by way of example only for a drill pipe and not intended to be limiting, with reference to the drawings, of which;

Figure 1 shows a longitudinal section of a drillpipe string installed in the well at surface;

Figure 2 shows an enlarged view of the top of the drill pipe of fig. 1 showing the connection means for the cable spool;

Figure 3 shows an enlarged view of fig. 1 in the region of the spool as a section of drill pipe is being deployed;

Figure 4 shows a similar view to fig. 3 with the spool in the position of being anchored to a section of drill pipe;

Figure 5 shows a similar view to fig. 3 with the spool including a guide means for the cable and cable anchoring means arranged in the drill pipe;

Figure 6 shows a similar view to fig. 5 after the cable anchoring means having been deployed;

Figure 7 shows a similar view to fig. 3 of an alternative embodiment of the anchoring mans provided by a magnetic means on the cable;

Figure 7a shows an embodiment of a magnetic means in the form of a magnetic tape;

Figure 7b shows an embodiment of the magnetic means in the form of a magnetic layer;

Figure 7c shows an embodiment of a magnetic means being provided by magnetising a steel sheath around the cable;

Figures 7d to 7f show the attachment of the magnetic tape to the cable and the inside wall of the drill pipe;

Figure 8 shows a the spool including ring shaped anchors arranged intermittently along the length of the cable;

Figure 9 shows a means of removal of the cable and anchors;

Figures 10a to 10d show an embodiment of a magnetic attaching means and its removal;

Figures 11 to 13 show an alternative embodiment of the use of a magnetic anchoring means;

Figures 14 and 15 show a method of removal of the cable and anchoring means of the embodiment in Figures 11 to 13;

Figures 16 to 19 show a further embodiment of a magnetic fixing means for the cable;

Figures 20 to 23 show the accomplishment of a wiper trip;

Figure 24 is a cross section of a cable according to a further embodiment of the invention,

Figure 25 is a longitudinal elevation of the cable of Figure 24;

Figure 26 shows a longitudinal section of the cable in Figure 24 in the fitted position secured to the drill pipe;

Figure 27 is a longitudinal section of a drill pipe including the cable of Figure 24 being installed;

Figure 28 is a longitudinal section of another embodiment of the cable system installed in the drillpipe;

Figures 29 to 31 are longitudinal sections of this embodiment showing cable being installed;

Figures 32 to 35 are longitudinal sections of the grippers of this embodiment in use;

Figures 36 to 39 are longitudinal sections of a another embodiment of the grippers in use;

Figures 40 to 41 are longitudinal sections of a further embodiment of the grippers in use; and

Figures 42 to 43 are longitudinal sections of this embodiment being removed.

Figure 1 shows the drilling assembly 1 lowered into a well with a cable module 2 installed in the internal bore.

The drill assembly is advanced down the well by a top drive with standard fluid entry above a goose neck 11 in the conventional way. As shown in figure 2, the cable module is attached to a connection means in a winch assembly above the top drive. When the drill string's progression down the bore hole makes it necessary to add another pipe section to the drill string, the cable module 2 is disconnected from the connection means and allowed to rest upon an anchor 5 which holds it in position against the drillpipe. The new pipe section is added to the existing drillpipe, and the top drive and winch assembly connected to the drillpipe. The winch means is ideally driven by an electric motor 13 supplied through a slip ring assembly 15. Further details of the connection means and winch assembly discussed in greater detail below. When the top drive is secured to the new pipe section, the connection means are lowered through the new pipe assembly until they engage with the cable module 2. The drill pipe proceeds downwards as the drilling progresses and the cable module pays out the cable along the length of the drill pipe until the top end of the new pipe section is reached and the process is repeated.

The method of data transfer between the stinger 8 and fishing socket 9 of the cable module 2 is preferably by an inductive link. In this way, data may be continuously transmitted throughout the drilling process, by induction when the fishing socket 9 is engaged or close to the stinger 8 when the fishing socket are separated, and may transmit even when new drill pipe sections are being added.

Referring to Figure 3, an enlarged view of the cable module 2 is shown as a section of drill pipe is being deployed. The cable module includes a storage container 12 in which is stored the armoured cable to be installed in the drill pipe. The cable is fed out of the storage container as it is pulled out with the running tool. Cable anchors 10 are stored below the cable storage container 12 and arranged so that after a desired length of cable has been paid out an anchor will be released and will fall into position to anchor the cable against the upset of the inside wall of the drill pipe. In this embodiment the anchor is a ring shaped anchor corresponding to the inside diameter of the drill pipe and which grips the cable against an internal upset or rim 14 on the inside wall of the drill pipe normally present at the joining point of the rill pipe section. The anchors could be arranged to be deployed one for each length of drill pipe but it is preferably only required to deploy them at every 3 to 5 joints of drill pipe.

Figure 4 shows a similar view to fig. 3 with the spool module in the position of being anchored to a section of drill pipe by anchors 5 which act against the internal upset 14 at the lower joint of the last connected drill pipe section. Fluid flow is possible both through the inside of the module F2 through ports 16 in the stinger 8 and also around the outside F1. This ensures that the drilling process can continue uninterrupted as new sections of drill pipe are added and the cable is paid out and anchored.

Figure 5 shows further embodiment of the anchoring means for the cable to the inside wall of the pipe. The same components have the same references and the spool module 2 includes a guide means 18 for feeding for the cable to the desired position against the inside wall of the drill pipe, and as in previous embodiments, fluid flow is both in the annulus around the spool holder and through a central bore of the spool holder. In this embodiment a

cable clamp is arranged at the joint of two corresponding pipe sections and held open before being activated to engage the cable and grip it to the pipe section. A j-pin may be used to correctly orient the spool holder.

Figure 6 shows a similar view to fig. 5 after drill pipe has moved downwardly and the cable anchoring means having been deployed, and the cable clamp has pivoted to retain the cable after the spool holder has moved past.

Figure 7 shows a further embodiment of the anchoring means provided by a magnetic means on the cable. This embodiment also includes a feeder 18 to push the cable against the inside wall of the drill pipe so that it becomes attached by means of magnetism. In this case the cable guide or feeder 18 would need to be made from a suitable non magnetic material, probably a suitable plastic.

Figure 7a shows one form of the magnetic means on the cable in the form of a flexible magnetic tape 22 which in this embodiment is adhered to the steel casings 6 of the twin fibre optic cables 6a. Figure 7b shows an embodiment of the magnetic means in the form of a magnetic layer 23 completely surrounding the casing 6 of the fibre optic cable 6a. The tape and magnetic layer preferably consist of a permanently magnetic material.

Figure 7c shows an embodiment of a magnetic means being provided by magnetising the steel casing or sheath 6 around a copper conductor 6a by means of a magnetising coil 24 to effectively permanently magnetise the steel casing. This can be carried out shortly before the cable is paid out so that the magnetic effect doe not effect the handling of the cable up to that

point but the cable will then affix itself to the inside wall of the steel drill pipe by means of its magnetic attraction.

Figures 7d to 7f show the attachment of the magnetic tape to the cable and the inside wall of the drill pipe. In fig 7d a V shaped recess 23 is formed in the tape 22 in which the cable 6 is pressed, and the V shaped tape deforms around the curved outside surface of the cable 6. Ferrous particles 23 within the tape provide the required magnetically attracting properties. Preferably, as shown in fig 7e adhesive is applied at the bottom of the V and this serves to secure the cable and magnetic tape together. The flat surface of the magnetic tape is then attracted and magnetically attaches to the inside wall of the drillpipe 1.

Figure 8 shows a the spool 2 including ring shaped anchors 26 arranged intermittently along the length of the wound cable 6. The ring shaped anchors 26 are released as the cable is paid out (each anchor being released as the spool portion beneath it is exhausted) and the anchors 26 will become arranged concentrically within the drill pipe and rest against the internal upset 14 of the drill pipe 1.

Figure 9 shows a means of removal of the cable 6 and anchors 26. A cable removing tool 30 is introduced into the well. The cable removing tool 30 includes a battery pack 32 a storage bin 33, guide wheels, or walk down wheels 34 for driving the removing tool along the inside wall of the pipe, chopping means 36 to break up the cable and anchors into small pieces and a cable gripping means 38 to grip the cable and feed it into the removing tool.

Figures 10a to 10d show an embodiment of a magnetic attaching means and its removal. The original cable 6 having a fibre optic wire 6a shown in figure 10a is encased in a layer of extrudable magnetic material 19 including a dissolvable metal component such as magnesium, shown in figure 10b. Such a layer could comprise particulate ferrous material, dispersed in magnesium and extruded around the outside of the cable. Thus when it is required to remove the cable acetic acid is pumped past the cable to rapidly dissolve the magnesium and so release the magnetic particles which disperse and are carried away by the mud, as shown progressively occurring in figures 10c and 10d..

Figs 11 to 13 show an alternative embodiment of the use of a magnetic anchoring means. Separate magnets 40 are attached to the cable 6 by attaching means such as straps 42. In fig 12 a cable with the magnets 40 already attached is being wound onto a bobbin 44 to formed the cable module 2, the feed spool being rotated in a perpendicular axis to the bobbin as shown by arrow *a* as the cable is wound onto the bobbin, so that cable is not in a twisted state when it is paid out from the bobbin. The cable ma be also be sprayed with silicone in order to releasably secure the cable in its wound configuration.. The completed cable module 2 is shown in fig 13 with lengths of wound cable interspersed with magnets housed in a thin-walled cylinder, the cable module including a cable guide 18 to urge the magnets into attractive contact with the inside wall of the pipe 1.

Figs 14 and 15 show a method of removal of the cable and anchoring means of the embodiment in figs 11 to 13. A winch line 51 with a fishing hook 52 at the lower end of it is lowered into a pipe line in which the already installed cable is present attached by magnetic attaching means. The fishing hook 52 latches onto the cable 6, 50, preferably at a fishing head provided

on the cable or the anchoring means. After the cable 50 is disengaged from the spool assembly and the cable 50 above the spool assembly is peeled back away from the inside wall of the pipe 2 the upward force on the winch line is sufficient to overcome the magnetic attractive force of the anchoring means. The force required to remove a single magnets, or small length of magnetic tape, by this 'peeling' technique is relatively small, and once separated from the wall of the drill pipe, the magnetic attraction is very much reduced and the line and magnets may be removed easily.

A further embodiment is shown in figures 16 to 19, in which magnetic elements are provided along the length of the cable to attach the cable to the inside wall of the pipe. In this embodiment the magnetic elements are fitted to the cable as the cable is deployed and paid out from the spool. Fig 16 shows the magnetic element 26 already attached to the cable 6 and secured thereto by means of an elastic element 61. The magnetic element is provided in two parts 26a and 26b and before the magnetic element is deployed these two parts are held apart against the retaining force of the elastic element 61 by a holding rods 62. These holding rods extend along the entire length of a number of magnetic elements corresponding ideally to the number desired to be deployed for the entire length of cable provide on the spool. The cable also runs between the entire number of magnetic elements and is arranged between the two holding rods 62 is the space provided by two semi-circular grooves 63 one in each of the magnetic element parts 26a, 26b. When it is required to attach a magnetic element to the cable the rods 62 are moved laterally away from the deploying end of the spool operated automatically by means of a motorised screw or the like, such that when the rods are free of the outermost magnetic element the two parts 62 cease to be held apart by the rods 62 and are forced together by the elastic element 61 and so grip the cable 6 and are fixed to it.

The magnetic elements are guided to the inside wall of the pipe by the guide 18 so that the cable and the magnetic elements are out of the main effect of the flow of fluids within the pipe and are also induced to magnetically attach to the inside wall of the pipe.

Referring to figure 20 to 23, when a length of borehole has been drilled using drillstring 1 having cable 6 paid out from a main spool 2 and anchored in the drillstring as described, the drillstring's operators may anticipate that subsequent deeper lengths of borehole will require wiper trips to be made to drill out unconsolidated rock material that caves in behind the drill bit. Referring to figure 21, before such a length x of borehole is begun, a secondary spool 65 having cable 76 wound around it in the manner similar to that previously in respect of the main spool 2 is introduced into the drillstring, the cable 76 from the secondary spool 65 connecting to the top of the cable 6 from the main spool 2. As the drillstring progresses, as shown in figure 22, cable 76 is paid out from the secondary spool 2, which is pulled through each new drillpipe section 73 by the winch and stinger 8 in a similar way to that described for the main spool 2. The main spool 2 remains secured in a descending drillpipe section 72, and does not pay out further cable.

Before returning up the borehole to carry out the wiper trip, the secondary spool 65 and the cable 76 previously paid out from the secondary spool 65 can be recovered and disposed of, or alternatively the secondary spool can wind its cable back onto itself. In general the secondary spool's cable is conventional cable, though of course it too may be anchored using the principles herein disclosed.

After the wiper trip has been completed, the main spool is situated at the top of the borehole, as shown in figure 23. As it is often necessary to complete several wiper trips over any one length of borehole (though of course this depends upon the characteristics of the rock), for each subsequent wiper trip a new secondary spool is installed in the drillstring. In this way, the drillstring's operators can be assured that during these wiper trips the cable beneath the main spool is secured anchored. It is of course possible that after a wiper trip has been completed, the main spool could be used once more to pay out cable (without using a secondary spool). But in general this is not envisaged.

Referring to figs 24 to 27 a further embodiment of the invention is shown in which the cable comprises an outer material of an rubberised or elastomeric substance 66 comprising concave shapes or dimples 67 in its outer surface which serve to provide a suckering effect between the cable and the inside wall of the drill pipe 1. In this embodiment the dimples 67 are provided on fours sides around the circumference of the cable 66 so as to provide a suction effect regardless of the orientation of the cable 66 and the dimples 67 are also located regularly along the length of the cable 66.

Fig. 26 shows the cable 66 in position secured against the inside surface of the drill pipe 1. Once establish the suction pressure will be substantial as it will be increased by the increasing hydrostatic pressure as the drill pipe progresses down the well. In fig. 27 it can be seen that the rubber coated suction pad cable 66 is deployed in a similar way to the previous embodiment with the guide 18 urging the cable 66 against the inside wall of the drill pipe 1 preferably resulting in a pressing of the cable against the wall so that a little air is urged out of the cavity formed by the concave dimple and the wall of the casing causing the suction effect as the

elastomeric material of the wall of the cable recovers immediately following the release of the pressing effect by the guide 18.

Referring to figure 28 a cable 6 terminates at the bottom of the bore of drill string 1 as previously described. The cable extends up the drillstring 1, being secured by grippers 70 located at regular intervals along the drillstring. In this embodiment, these grippers could typically be located in ever 1000 feet (though naturally this could be varied, and will depend upon the type of cable; as in the first embodiment, where armoured cable is employed, the grippers may be more frequently deployed), so that for standard length drillpipe sections of about 30 foot, a gripper 70 will be located in every thirtieth drillpipe section. Additional cable is stored wound around a the spool of a cable module 2 of a which is suspended near the top of the drillstring.

The cable module and top of the drillstring is shown in more detail in figure 29. Each gripper 70 is attached to the inner bore of a drillpipe section 72 on a hinge 71. When the drillpipe section is made up on the drillstring 1, the gripper 70 is in a retracted position as shown. As further drillpipe sections are added, the cable module 2 is threaded through the newly added drillpipe sections using a fishing tool and wireline; as previously described, ratcheted supports allow the cable module to be dragged through drillpipe sections but resist the cable module passing downwardly past the internal upset of the drillpipe sections. As the drillstring is extended, cable is paid out from the cable module, and guided to one side of the drillstring's bore by a tongue 74. As for the previous embodiments, the cable module ideally includes a through path F2 so that drilling fluid is not impeded even when the widest portions of the cable module are passing through the narrowest portions of the drillstring's bore.

Referring to figure 30, when it is desired to secure the cable 6 to the side of the drillstring bore, the gripper 70 is activated so as to pivot through 90 degrees to a horizontal position. The wall of the drillpipe section opposite the grippers hinge has a concavity 75 arcuate in profile, to accommodate the sweep of the gripper. The cable 6 is securely pressed against the side of the drillpipe section by the gripper 70. Referring to figure 31, when the drillstring 1 is being withdrawn from the borehole and the individual drillpipe sections are removed, the grippers 70 may be deactivated to release the cable 6.

The activation of the grippers may be achieved by hydrostatic means, i.e. by increasing the hydrostatic pressure in the well to particular levels, of by other smart or remote means. Alternative methods will be described below.

It will be realised that the gripper may be implemented or configured in different ways. Referring to figure 32, a gripper 80 is fitted inside a drillpipe section 72 secured by and pivoting upon a hinges 82 that engage on opposite points across the circumference of the drillpipe section's bore; the internal profile of the drillpipe section 72 is modified to accommodate the sweep of this gripper. As shown in figure 33, the cable 6 is threaded through the new drillpipe section 72 (the gripper is preferably shaped, for example in a C-shape, so as to accommodate the passage of the cable module). Referring to figure 32, the gripper 80 is controlled by a fuse 84 constraining the gripper's hinge (which is biased by a spring to urge the gripper to rotate through an activated position), which initially activates to pivot the gripper and grip the cable on contact with drilling fluid. The fuse is ideally set to activate the gripper's pivoting after a set time period e.g. 30 minutes, after the first contact with the drilling fluid. When it is desired to

release the cable, a set pressure (say 5000 psi) is applied to the drillstring at the surface, and a piston 86 in the gripper causes a shear pin to fail as shown in figure 35, deactivating the gripper which is then freed to pivot downwards, and releasing the cable 6 which may then be winched up and recovered.

Referring to figures 36 and 37, in an alternative embodiment a first fuse 92 is situated at the gripping region of the gripper 90, which it interlocks with a groove 93 on the inner surface of the drillpipe section 72. Once again, the cable 6 is introduced to the drillpipe section. The first fuse 92 may be composed of magnesium, so that it starts to dissolve with components of the drilling fluid when the drilling fluid comes into contact with the gripper 90. After a set time period, say around 30 minutes, the first fuse 92 has dissolved to the extent that the gripper 90 is free to pivot into an activated position and grip the cable against the inner wall of the drillpipe section, as shown in figure 38. Some or all of the gripper (or its pivoting support pins) is composed of titanium. When it is desired to release the cable, fluoride is introduced into the circulating fluid, causing the titanium to dissolve and the remaining parts of the gripper to falls away, releasing the cable as shown in figure 39.

Referring to figure 40, in a similar manner to previous embodiments, a hinged gripper 100 is located inside the drillpipe section 72. The hinge 104 is spring-loaded, and biased to pivot to the horizontal position, but is held in a deactivated, vertical state by a fuse 102. The fuse 102 is composed of magnesium, and dissolves after prolonged contact with the drilling fluid (typically 30 minutes, though of course this can be varied as desired). When the fuse has dissolved, the spring-loaded hinge 104 pivots the gripper

100 to a vertical position as shown in figure 41, to anchor the cable 6 to the drillpipe section wall.

The gripper 100 shown in this embodiment is generally annular, with a diameter somewhat less than the internal diameter of the drillpipe section 72. Referring also to figures 38 and 39, the annular gripper 100 includes a gripping surface 106 an the outside edge of the gripper, on the portion of the gripper opposite the gripper's hinge 104, which engages with the cable 6 and urges it securely against the side of the drillpipe section 72. Also provided by the gripper at this region is a release arm 105, which comprises an arm set upon a hinge 109 upon the gripper, the distal end of the arm extend towards the centre of the drillpipe section's bore. On the other side of the hinge 109 is supported a cutter 107 and a resilient gripper hook 108. Referring to figure 38, in order to release the cable 6 from the gripper, a wiper plug 110 is introduced to and pumped down the drillstring 1. As the wiper plug 110 passes through the gripper 100, it engages the release arm 105, causing it to pivot, thereby cutting the cable 6 at the point at which it is anchored, and the resilient gripping hook 108 re-anchors the cable 6 beneath the cut. The cable 6 above the gripper may now be retrieved.

In this manner the cable may be retrieved in manageable sections (ideally 1000 to 2000 feet long), as opposed to a single long length of cable (say 20,000 feet) which is prone to becoming snarled and knotted. It can be easily detected when the wiper plug has reached the gripper (since the lower end of the cable no longer be secured), and the pumping of the plug may then be paused until enough drillstring has been removed to access the drillpipe section having the topmost gripper. The top of the next section of cable may then be held whilst the cable is severed at the next gripper.

It will be seen that by securing cable (whether conductive cable, fibre-optic cable or some other type) the cable does not have to support its entire weight, and so need not be engineer to be as rugged and expensive as if such securement were not used but without the risk that the cable will break through the tension it experiences. Should the cable nevertheless break, problems due to snarled knotted lengths of cable (known as 'bird's nests') will be minimised since most of the length of the cable will remain secured by the grippers, and only an individual length between two consecutive grippers will be involved.

Alternative embodiments using the principles disclosed will suggest themselves to those skilled in the art, and it is intended that such alternatives are included within the scope of the invention, the scope of the invention being limited only by the claims.

CLAIMS

1. A pipe installation system, the pipe-line being composed of pipe sections which are added and removed to increase and decrease the length of the pipe, wherein a length of cable is disposed within the pipe, there being a cable storage means for stowing the cable in a compact manner and paying out the cable when the length of the pipe is increased such that the paid out cable is deployed in the increased length of pipe, wherein the anchoring means are provided which serve to attach the cable to an inside wall of the pipe following deployment of the cable in the pipe.

2. A pipe installation system according to claim 1, in which the anchors are attached to the cable at pore-determined positions a long the length of the cable.

3. A pipe installation system according to claim 2, wherein the anchors position themselves in an anchoring position as the cable is paid out.

4. A pipe installation system according to claim 2, wherein the anchors consist of a ring shaped wire which correspond approximately to the inside diameter of the pipe.

5 A pipe installation system according to claim 1, wherein the anchoring means is provided by the cable having magnetic elements attached to it at intermittent points along its length to attach the cable to the inside wall of the pipe magnetically.

6 A pipe installation system according to claim 1, wherein the cable includes a sheath of effectively permanently magnetisable material, such as steel, the sheath being magnetised shortly before deployment.

7 A pipe installation system according to claim 1, wherein the magnetic attractiveness is provided by a magnetic flexible tape attached to the conductor or a complete outer layer.

8 A pipe installation system according to claim 1, wherein the anchoring means may be provided by the inside wall of the pipe and activated as the spool passes through the pipe.

9 A pipe installation system according to claim 1, wherein the anchoring means is provided by the cable having suction elements attached to it at intermittent points along its length to attach the cable to the inside wall of the pipe by means of suction.

10 A pipe installation system according to claim 1, wherein the spool includes a cable feeder which guides the cable to the desired position inside the pipe.

11 A pipe installation system according to claim 1, wherein cable is guided against the inside wall of the pipe.

12 A pipe installation system according to claim 1, wherein the cable store means is a bobbin upon which the cable is wound.

13 A pipe installation system according to claim 1, wherein the cable includes a wireless transmitter capable of transmitting signals to a signal receiver.

14 A pipe installation system according to claim 1, wherein the cable is releasably connected to a connector at its top, the cable being disconnected from the connector when a pipe section is to be added or removed, threaded through the pipe section before being reconnected to the connector, the cable including a wireless transmitter, such that signals carried by the cable can be transmitted by the wireless transmitter to be received by a signal receiving means.

15 A method of installing pipe sections to form a pipe including installation of a continuous cable within the installed pipe comprising:
supporting a continuous length of cable arranged on a spool which is releasably connectable to a tension line within the pipe,
resting the spool on support means within the pipe,
disconnecting the tension line from the spool, and adding a new pipe section,
reconnecting the tension line to the spool to support the spool as the new pipe section is progressively fitted,
paying out of the cable from the spool.

16 A method according to claim 14 characterised in that the cable transmits data to surface whilst the spool is connected to the tension line.

17 A method according to claim 15, wherein data is transmitted from the cable to the surface whilst the spool is disconnected from the tension line by means of a radio frequency connection.

18 A pipe installation system, wherein there is provided a method of removing a cable installed along a pipe string or the like and fixed to the inside wall thereof by anchoring means, the pipe string being composed of pipe sections which are removed as the removal of the pipe string progresses, a length of cable being disposed within the pipe string, a cable removing means being releasably connected to a connector at its top, the cable removing means being adapted to remove the cable and the cable anchoring means.

19 A pipe installation system according to claim 17, wherein the cable removal means preferably includes means for applying a solvent to dissolve part of the cable or its anchoring means.

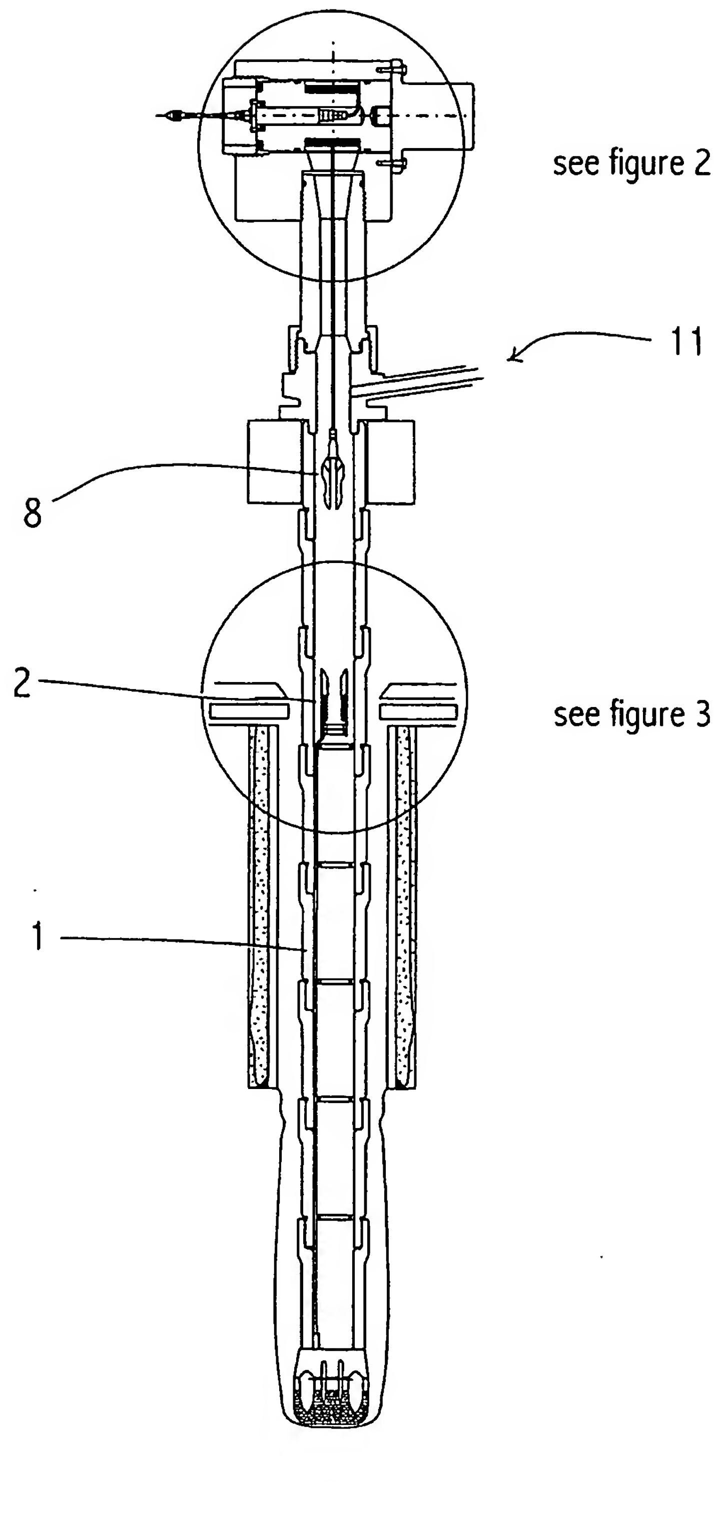


FIG 1

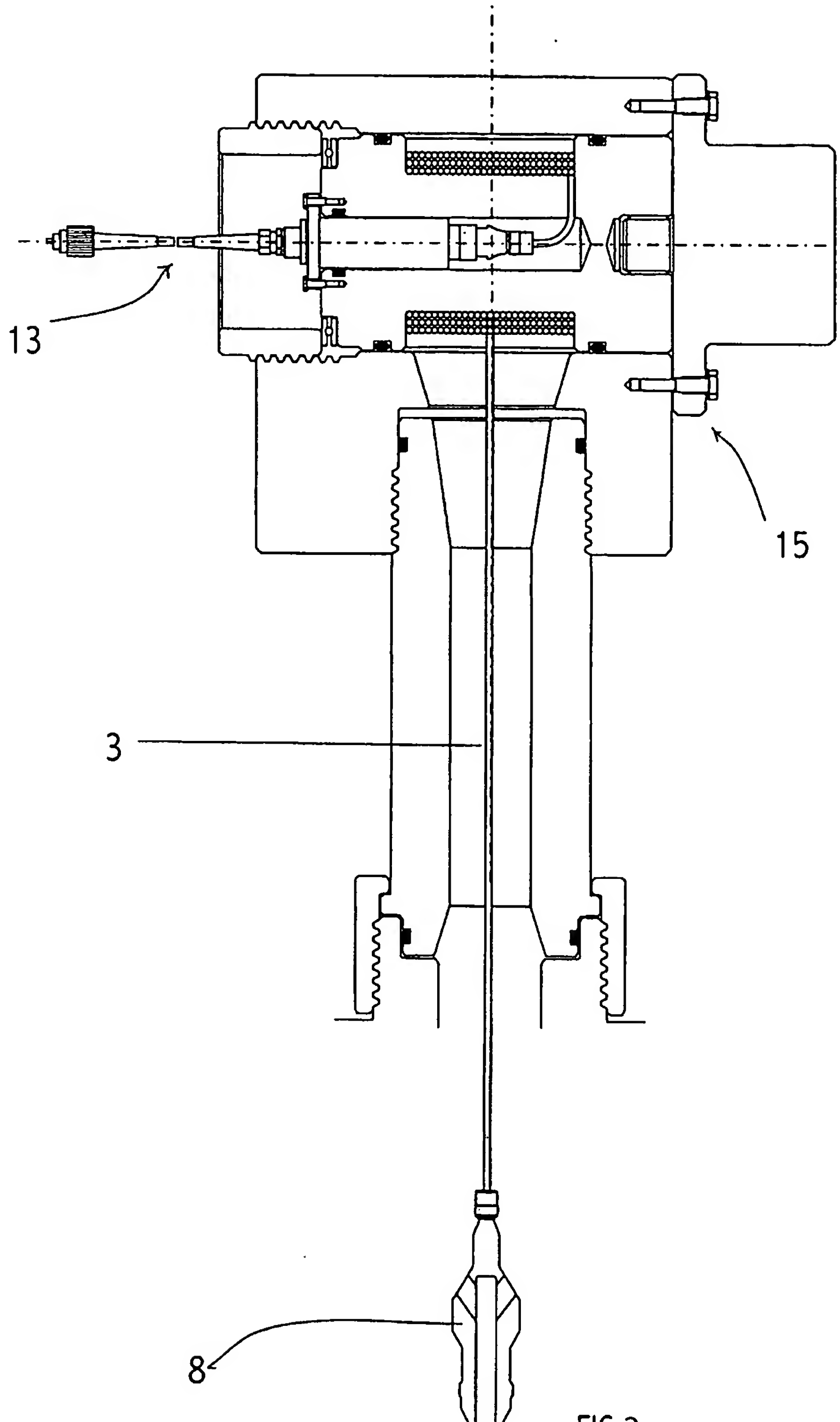


FIG 2

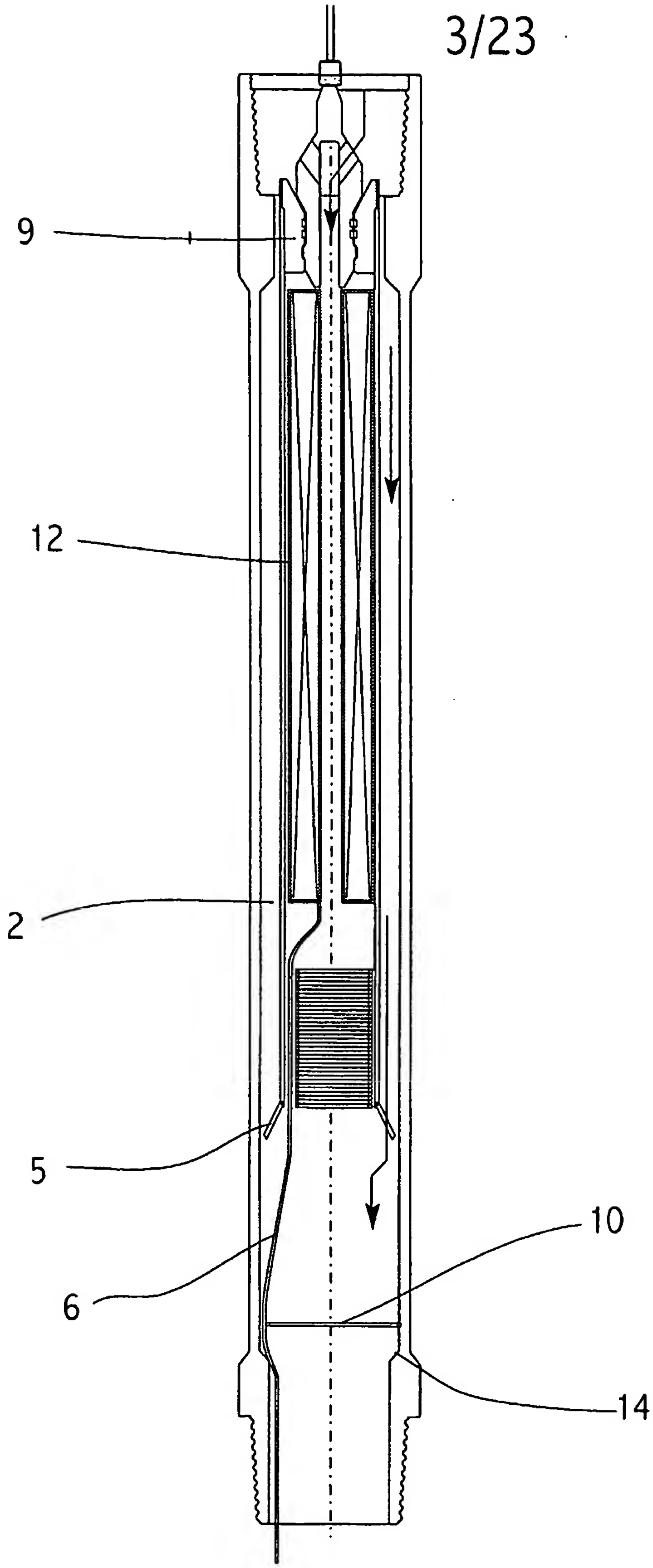


FIG 3

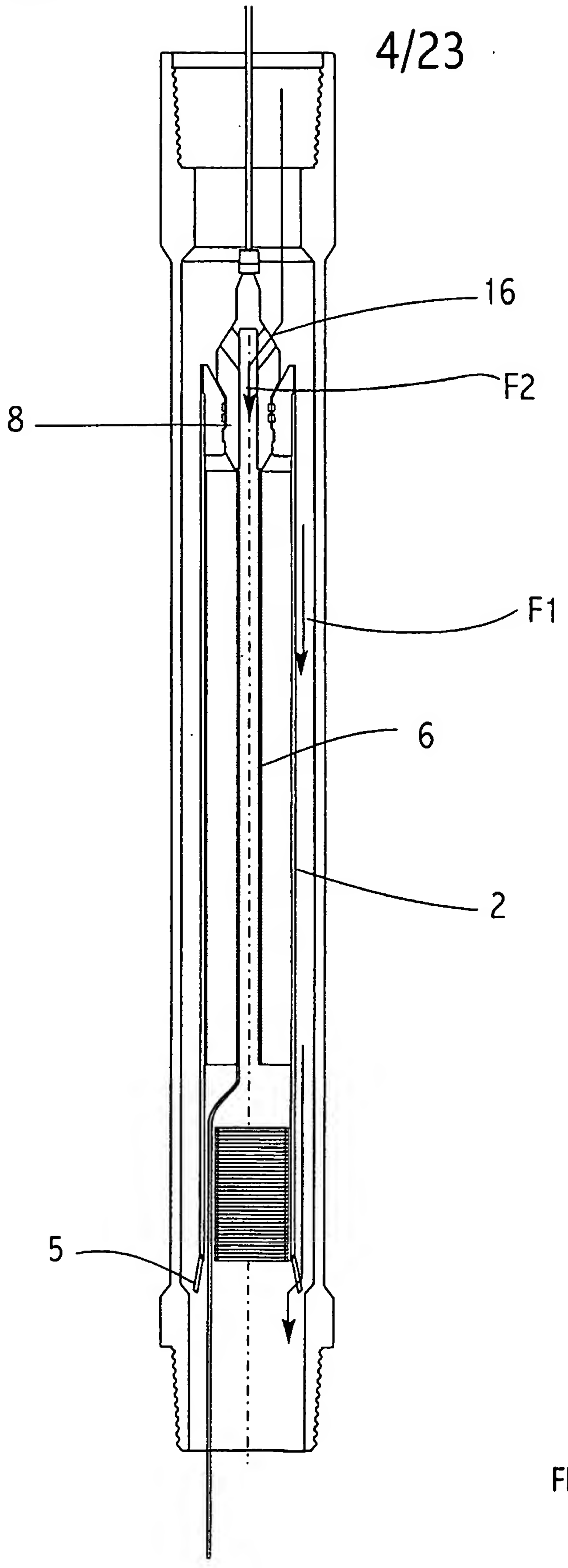


FIG 4

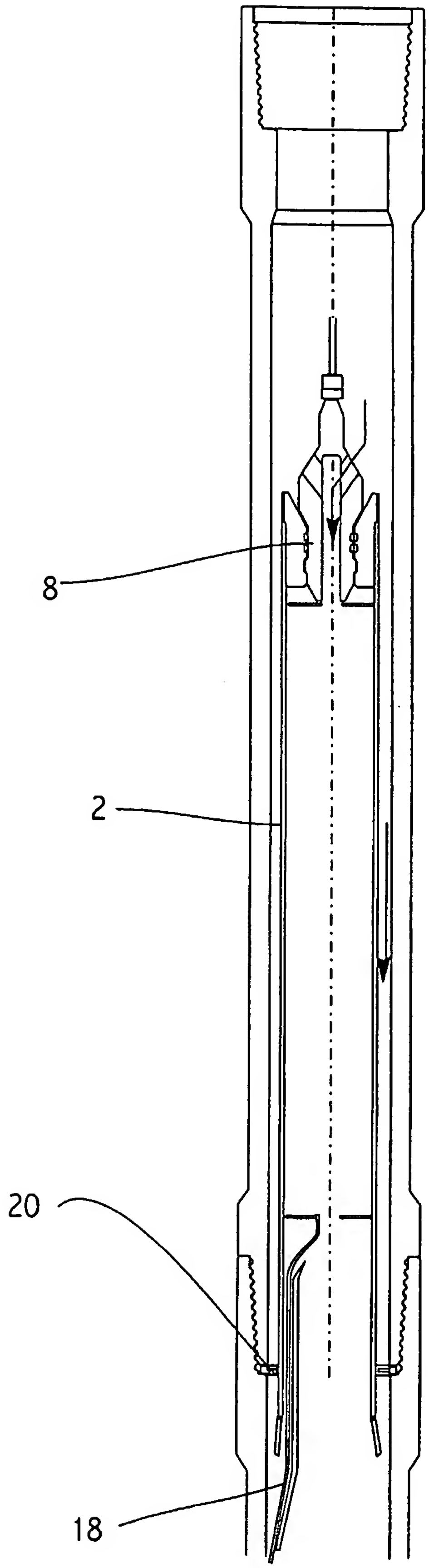


FIG 5

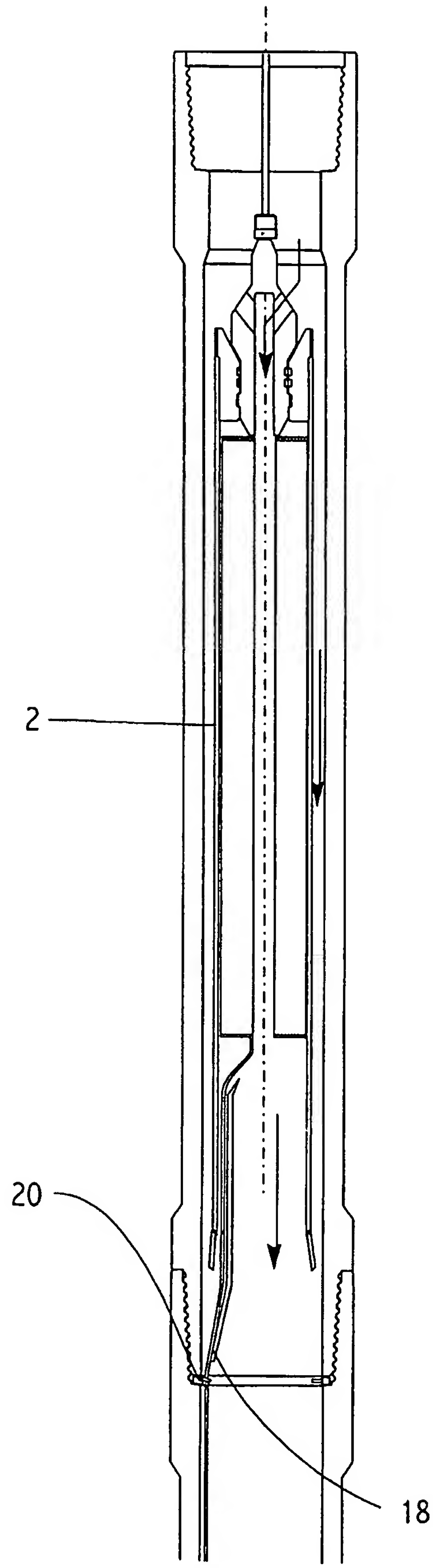


FIG 6

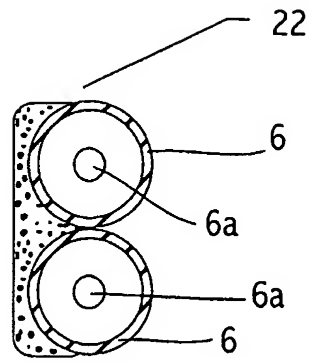


Fig. 7a

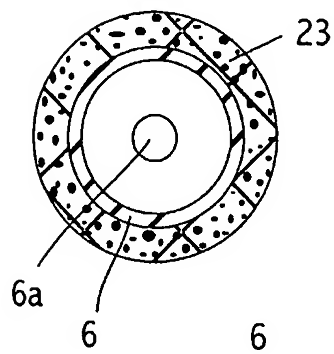


Fig. 7b

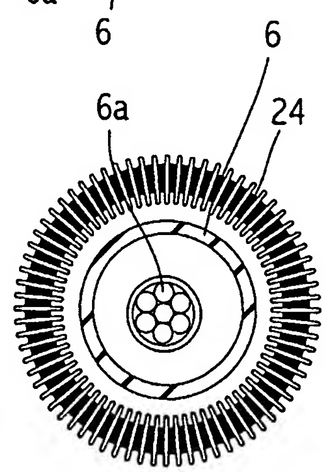


Fig. 7c

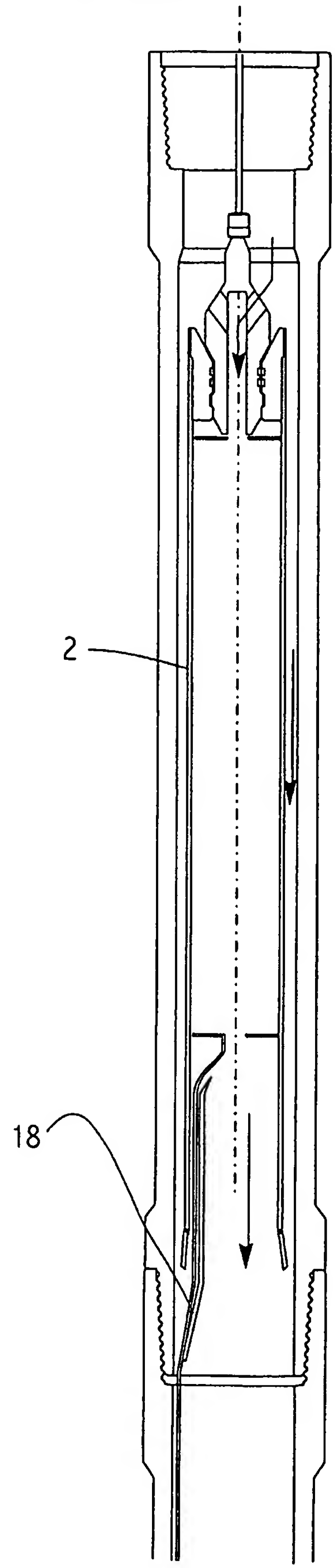


FIG 7

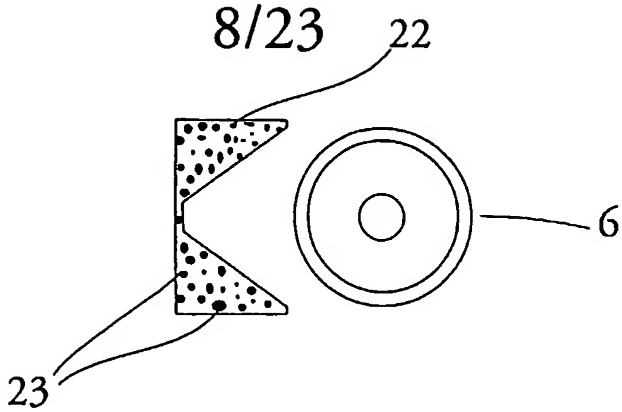


Fig. 7d

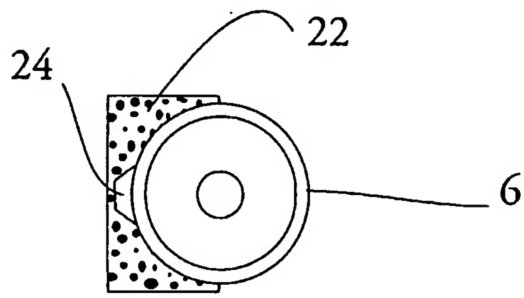


Fig. 7e

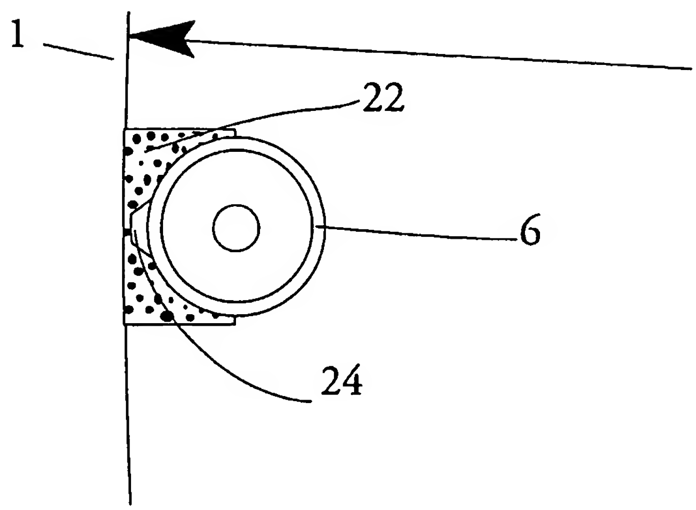


Fig. 7f

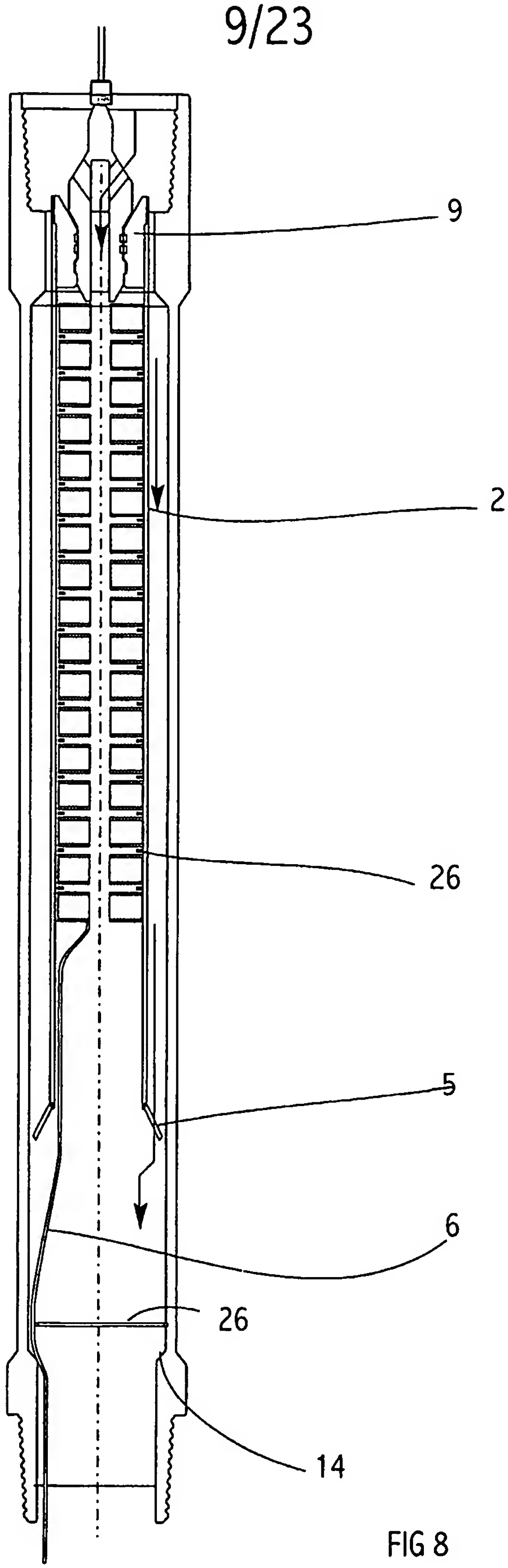


FIG 8

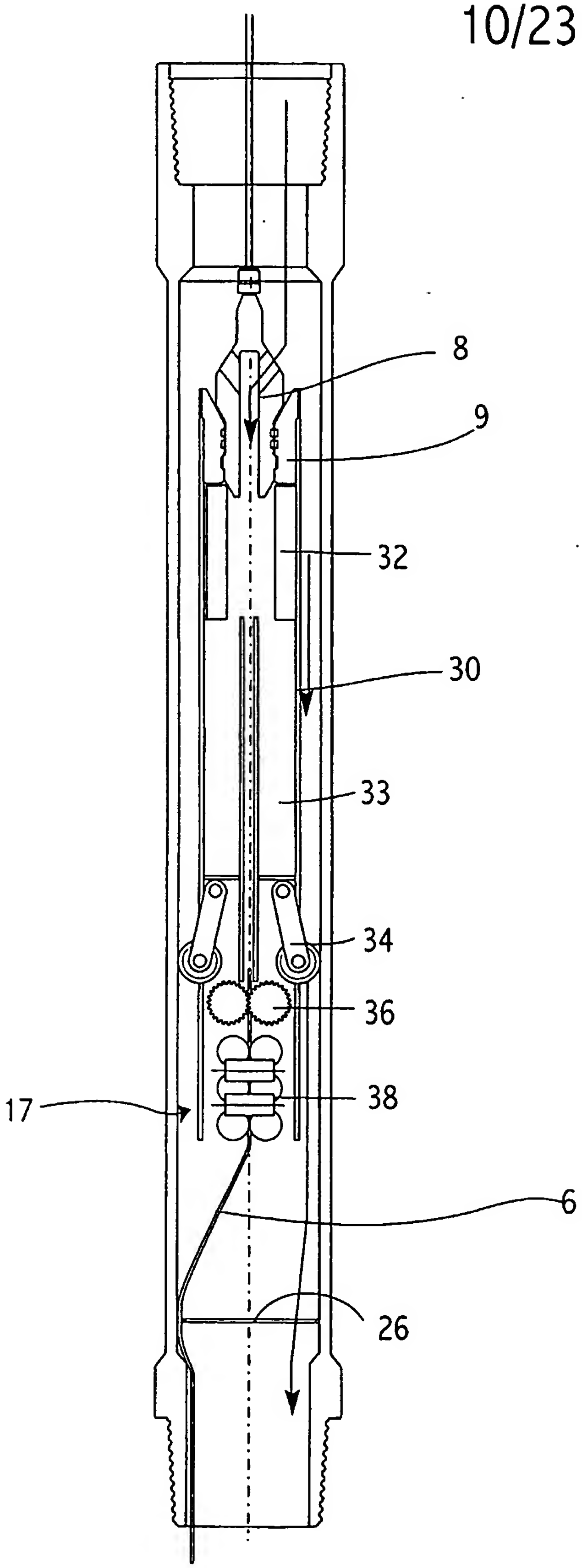


FIG 9

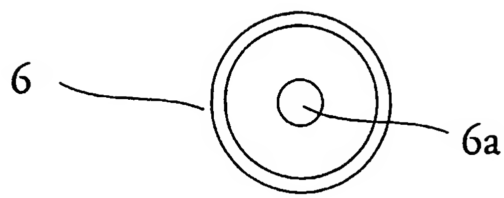


Fig.10a

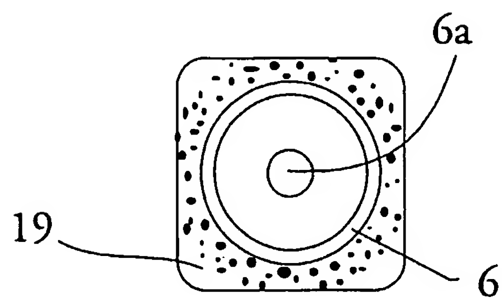


Fig. 10b

Fig. 10c

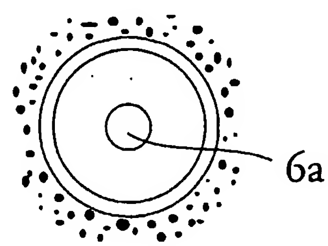
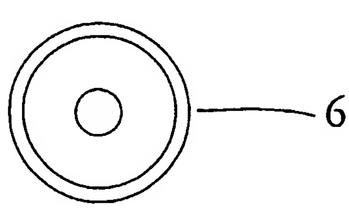


Fig. 10b



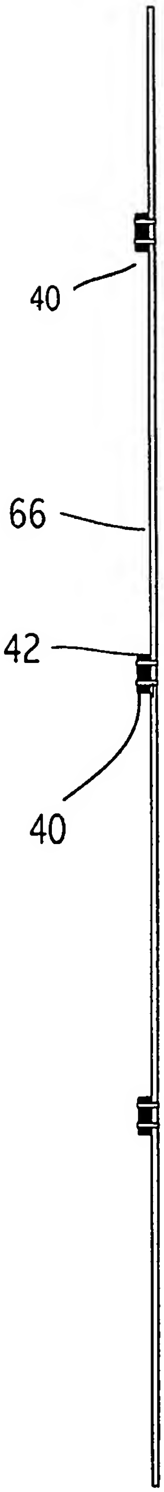


FIG 11

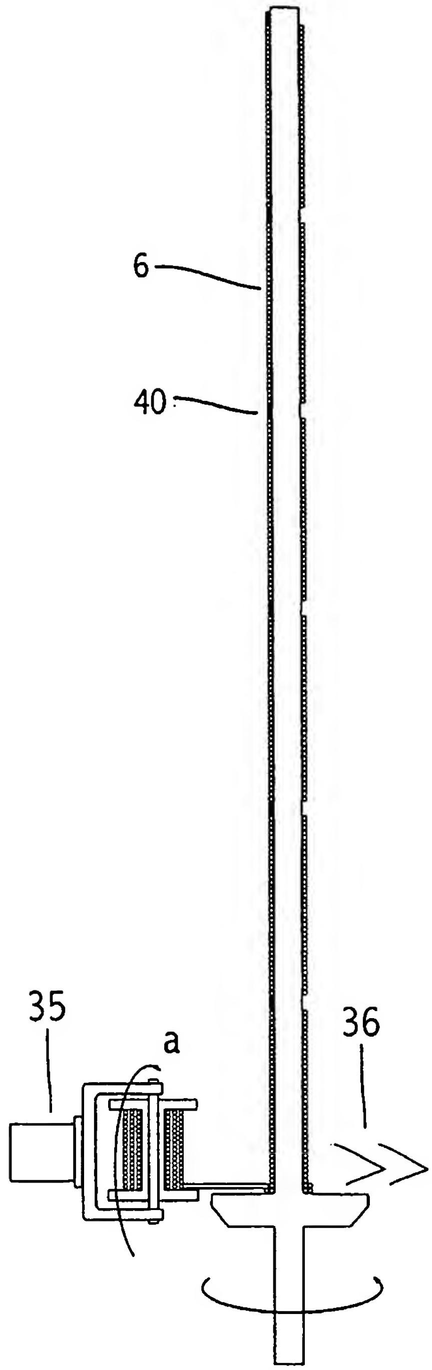


FIG 12

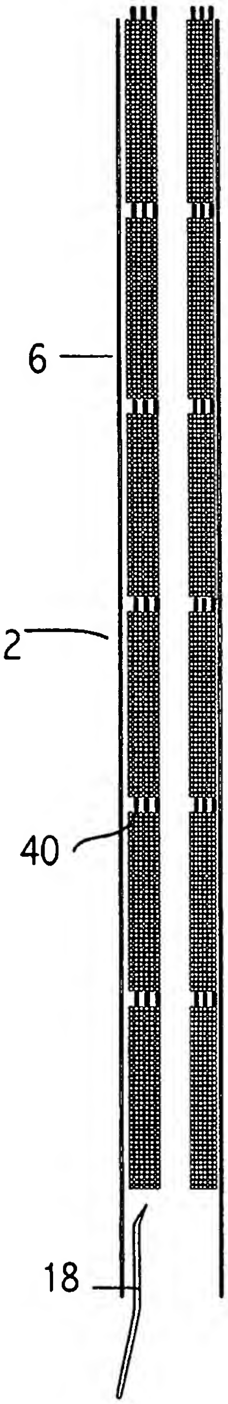


FIG 13

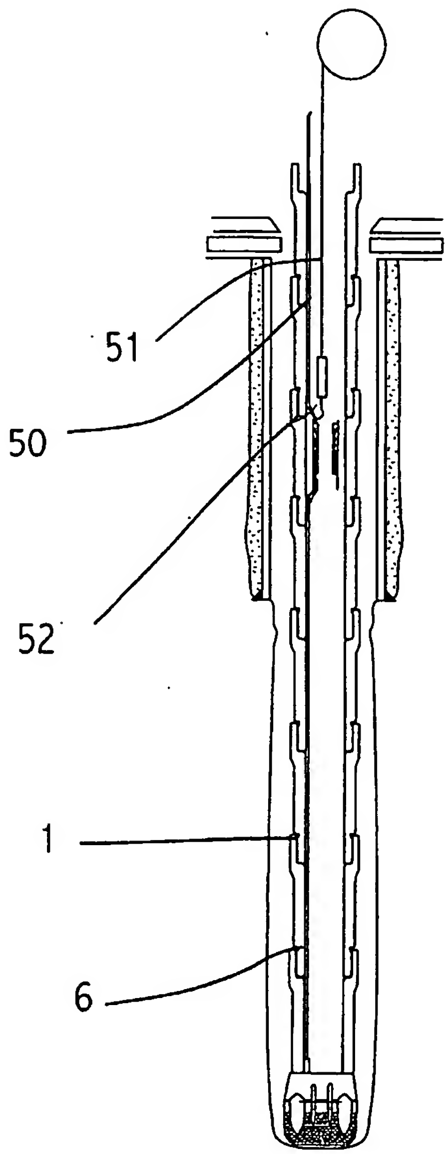


FIG 14

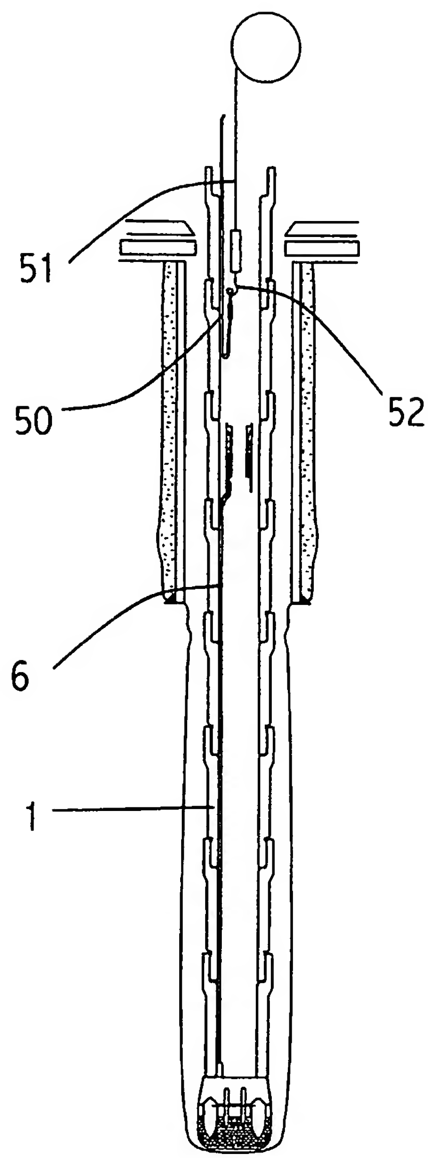


FIG 15

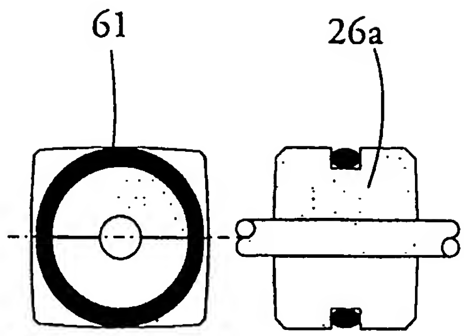


FIG 16

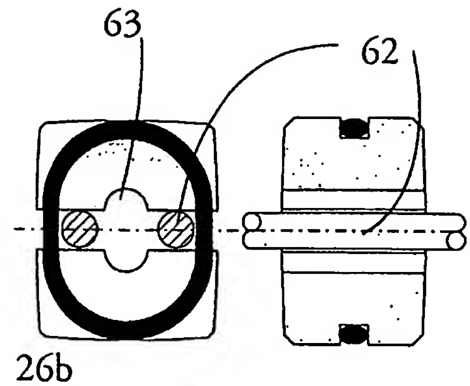


FIG 17

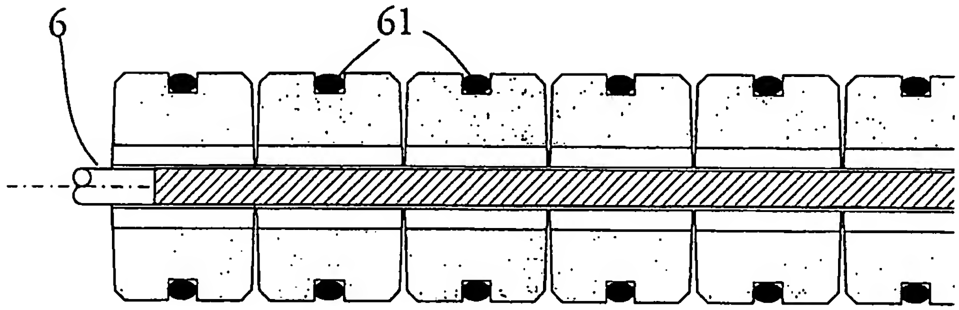


FIG 18

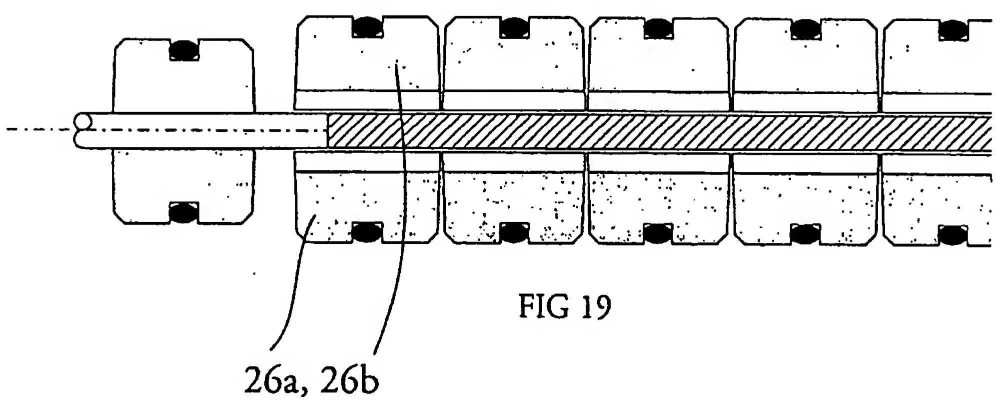


FIG 19

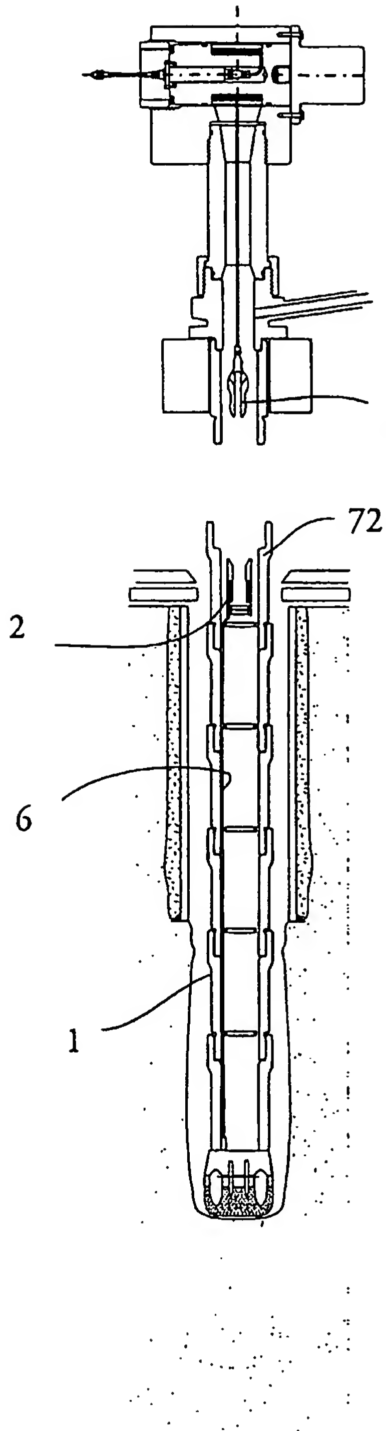


FIG 20

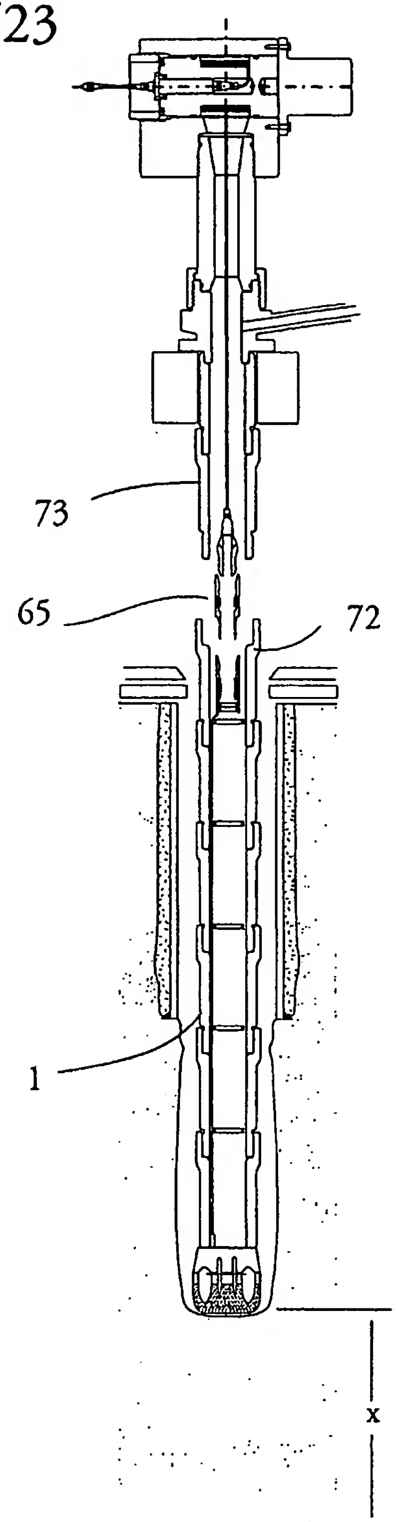


FIG 21

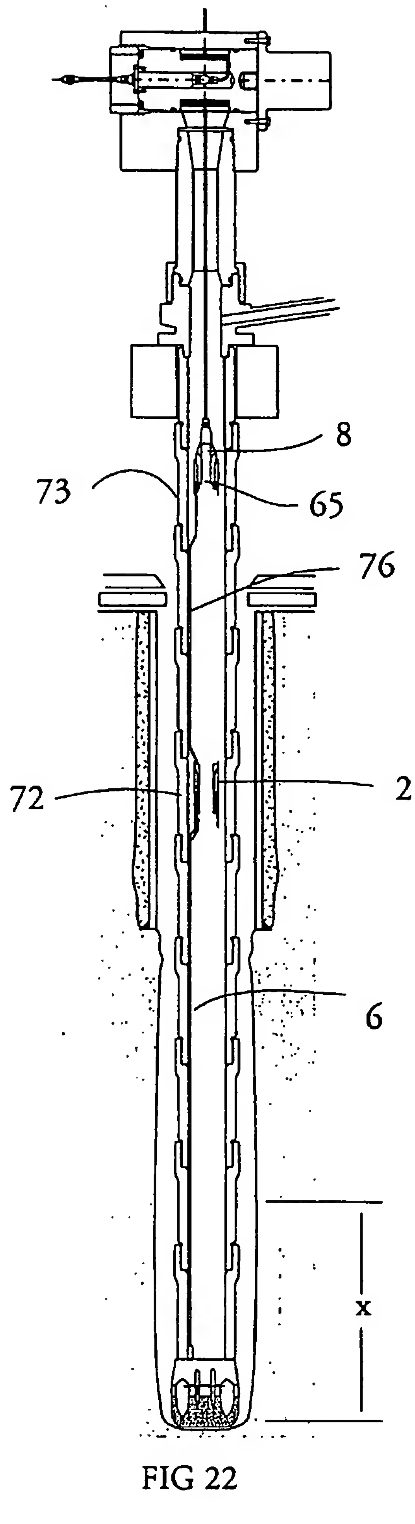


FIG 22

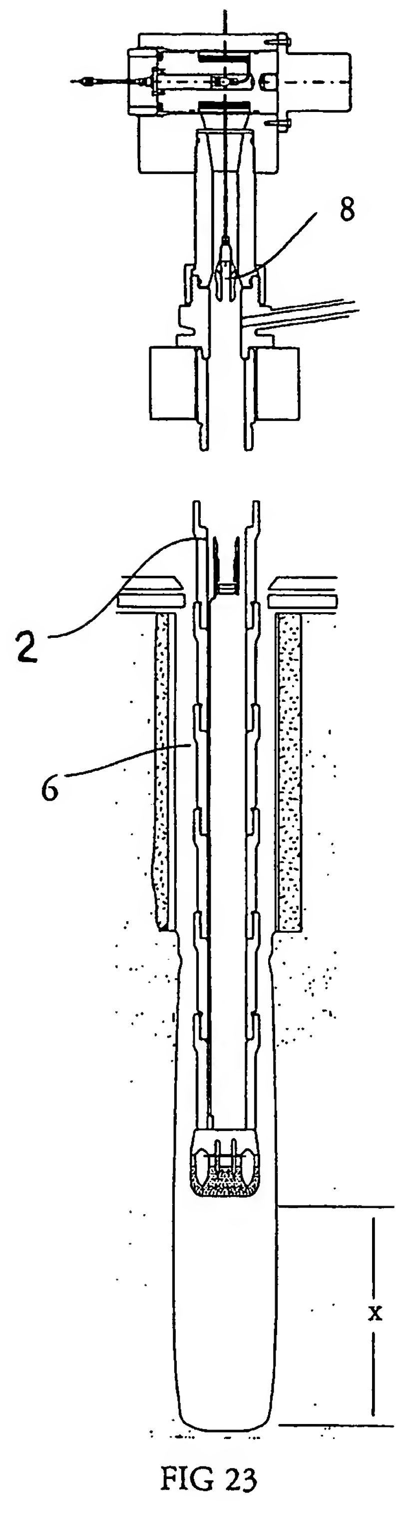


FIG 23

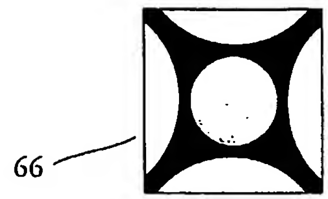


FIG 24

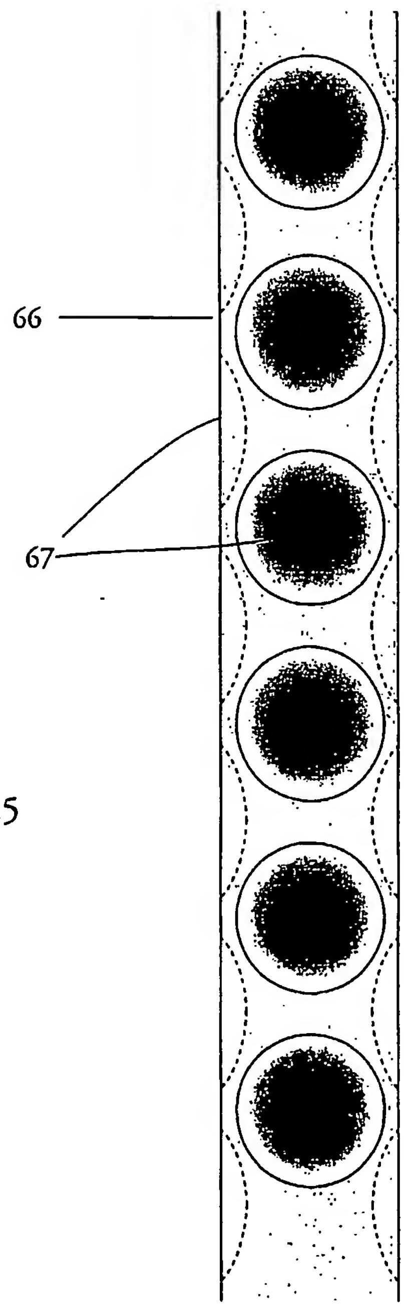


FIG 25

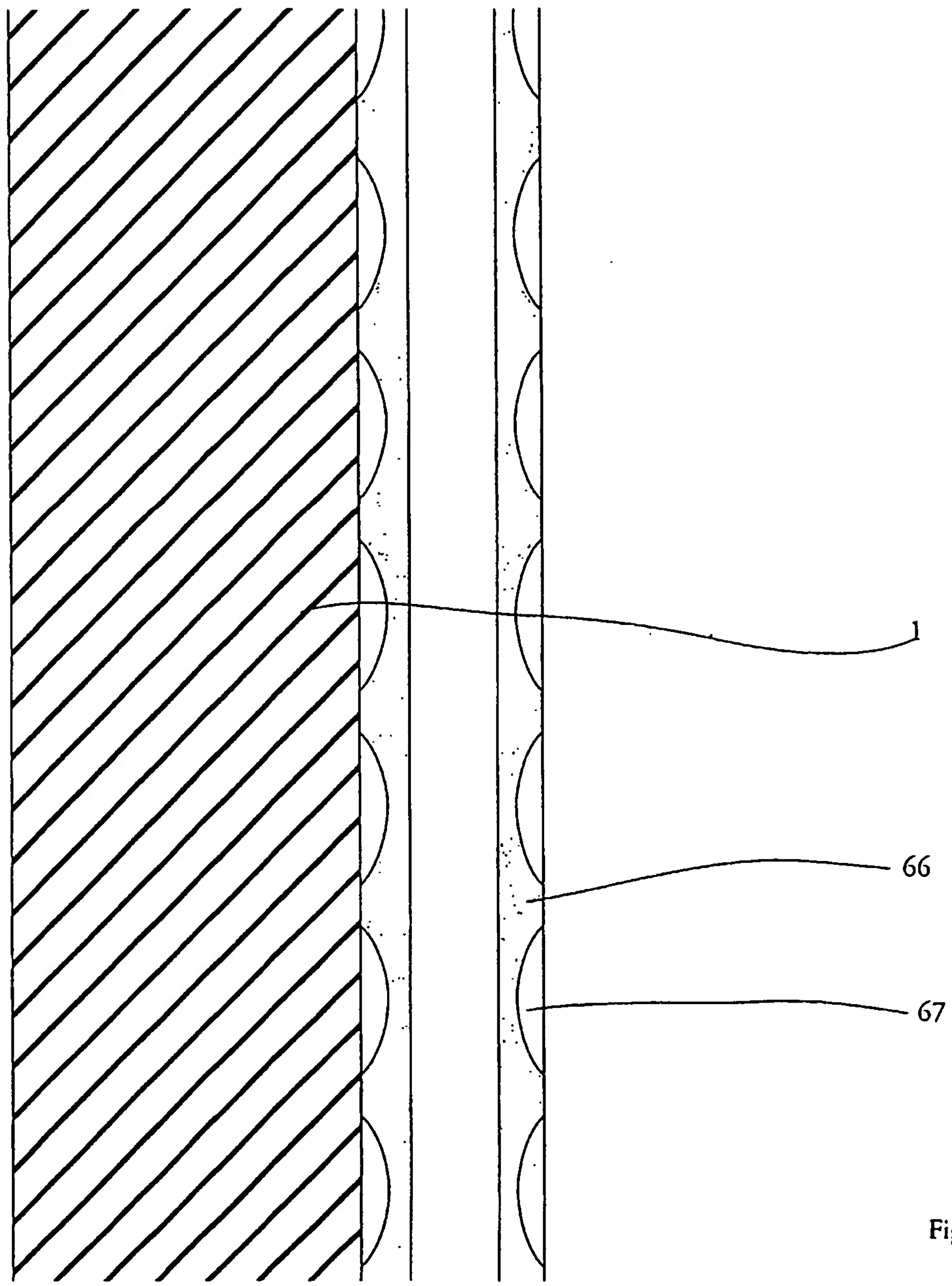


Fig. 26

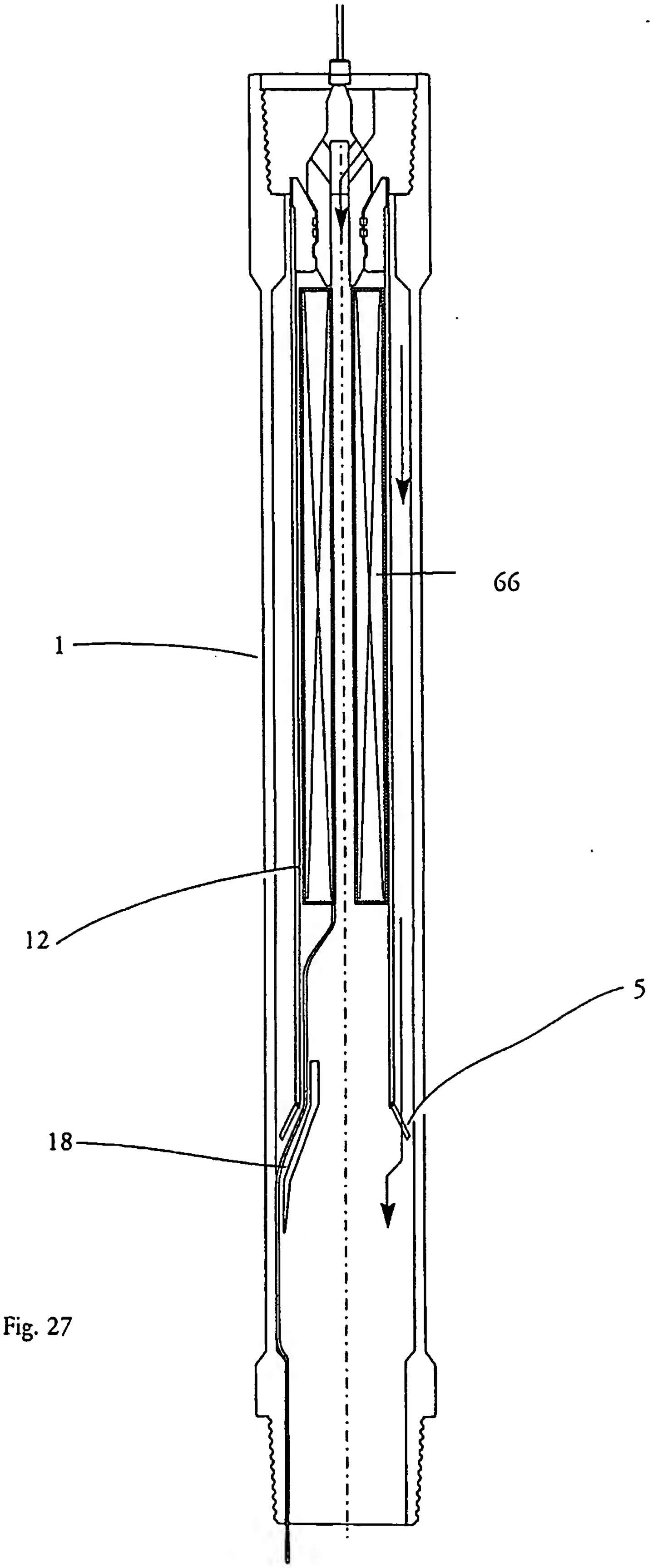


Fig. 27

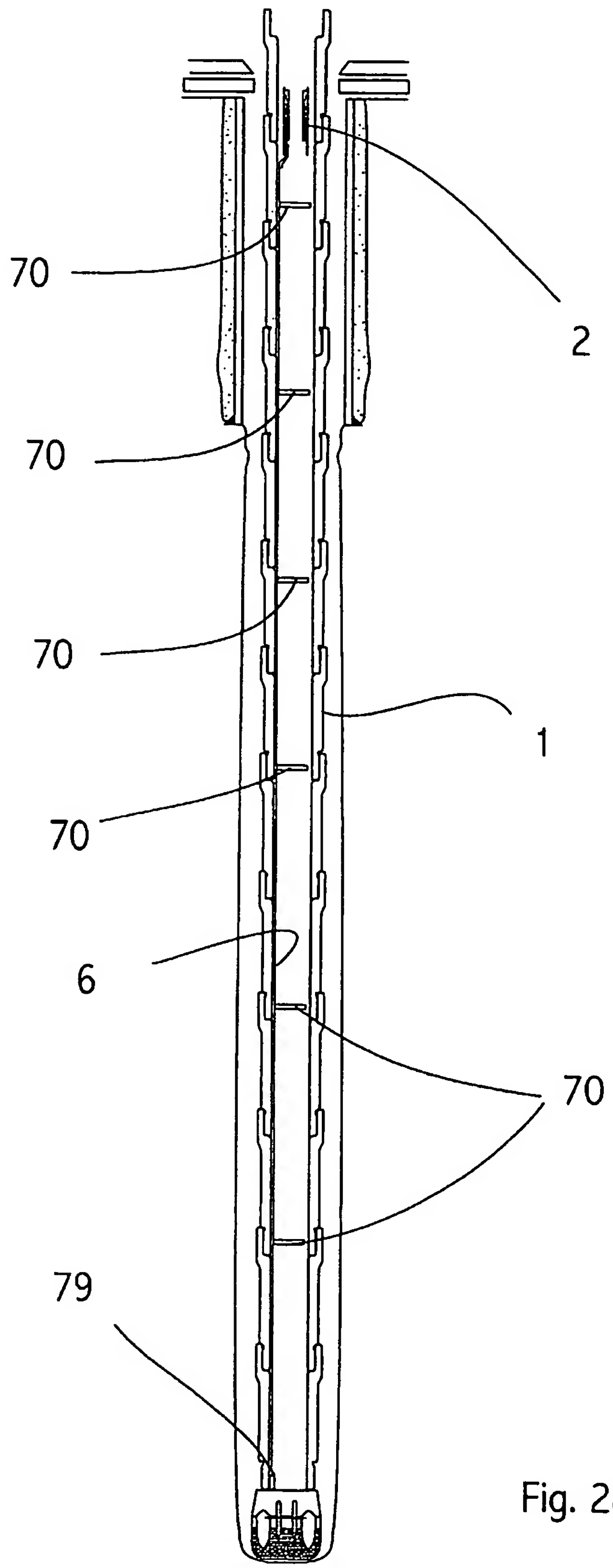


Fig. 28

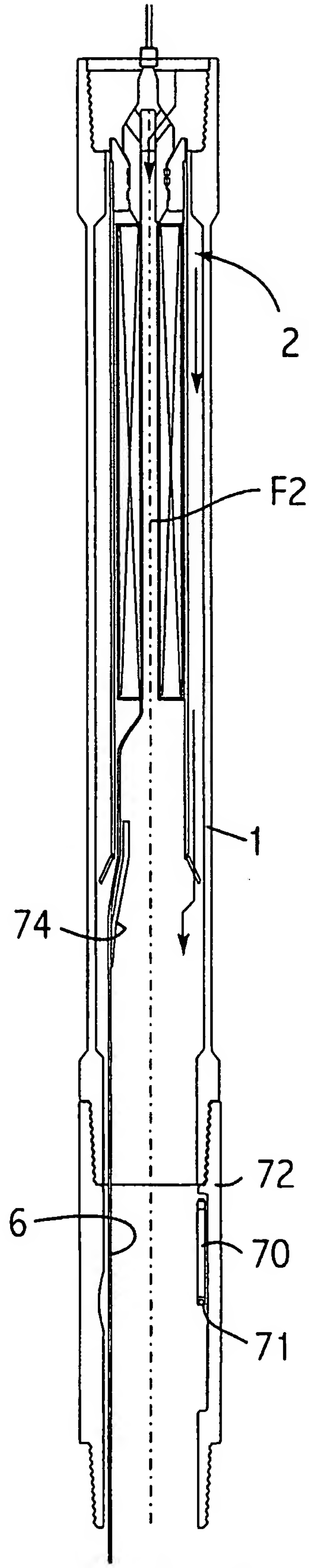


Fig. 29

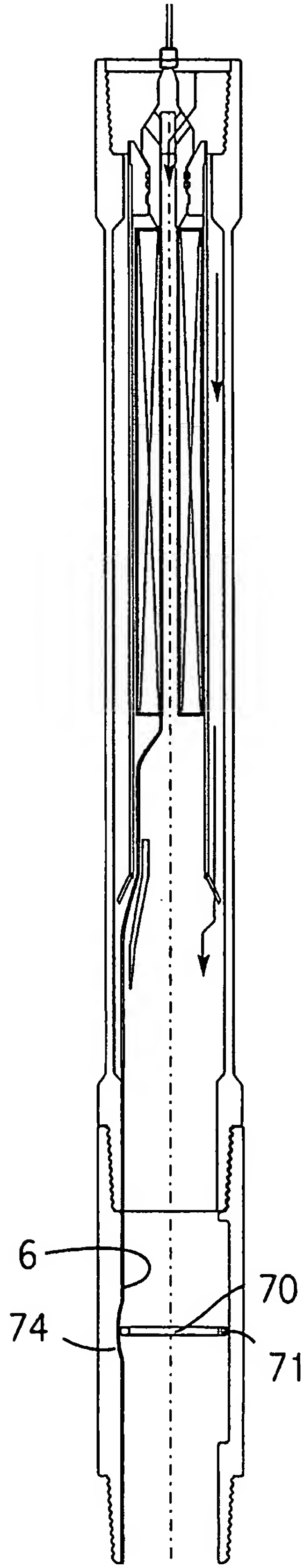


Fig. 30

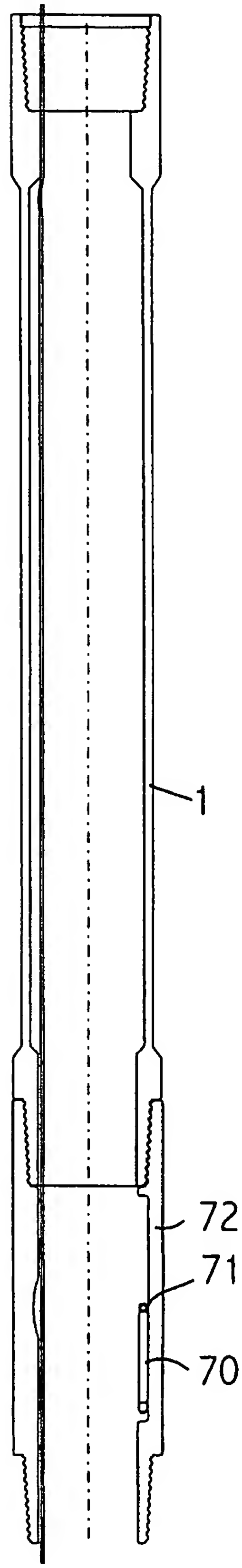


Fig. 31

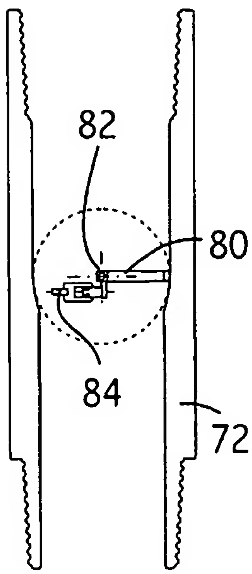


Fig. 32

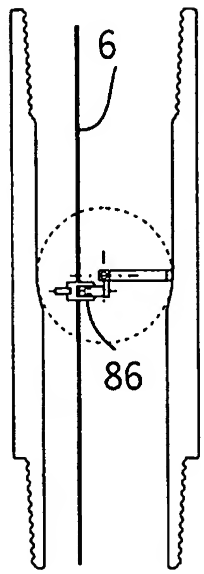


Fig. 33

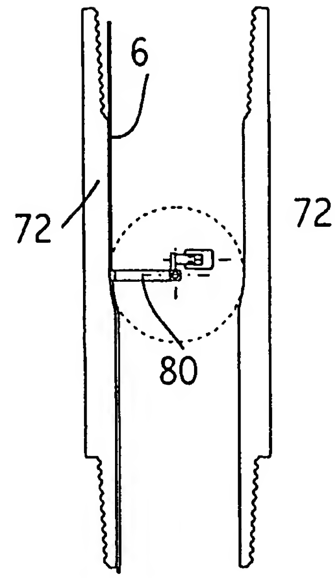


Fig. 34

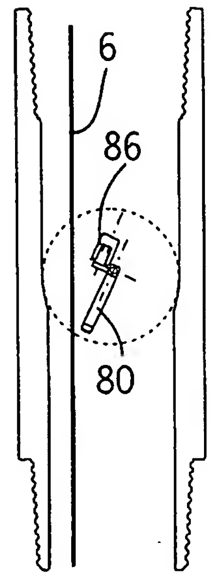


Fig. 35

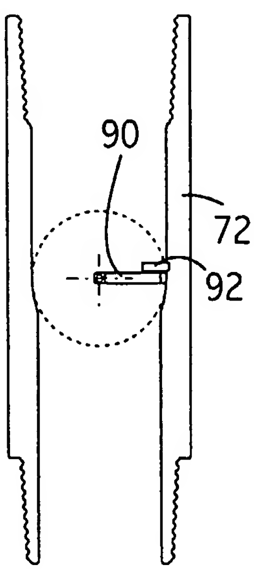


Fig. 36

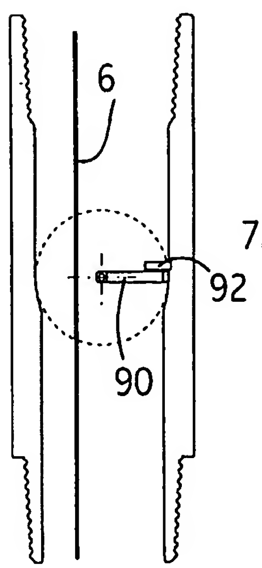


Fig. 37

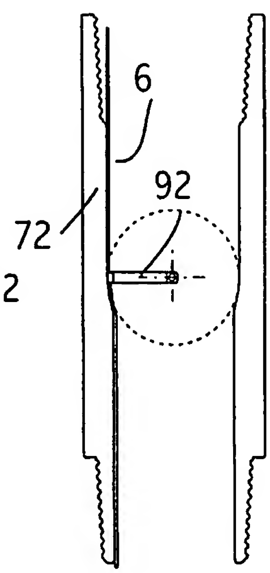


Fig. 38

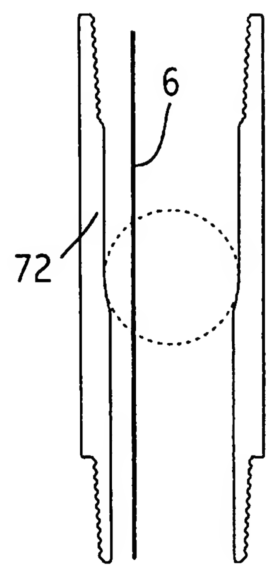
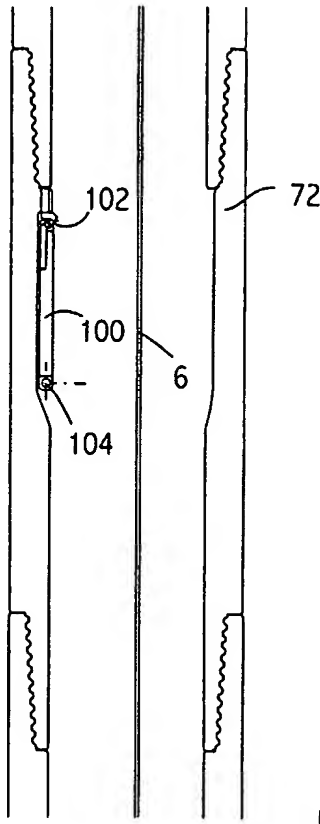


Fig. 39



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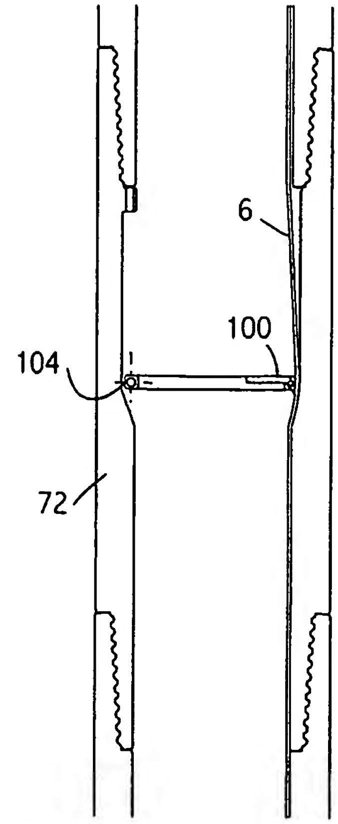

Fig. 41

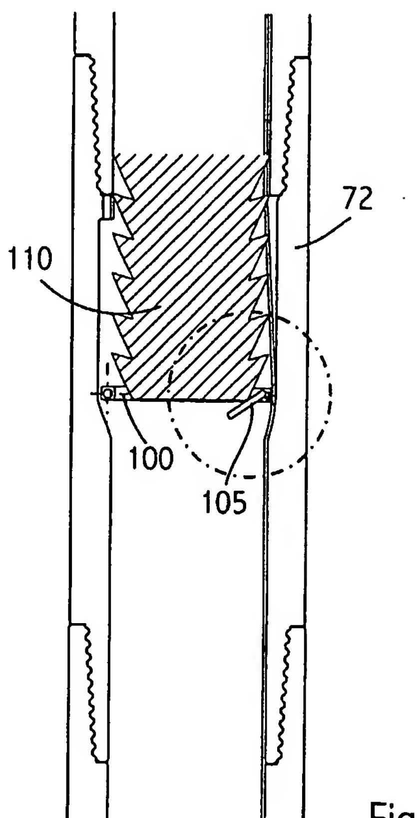

Fig. 42

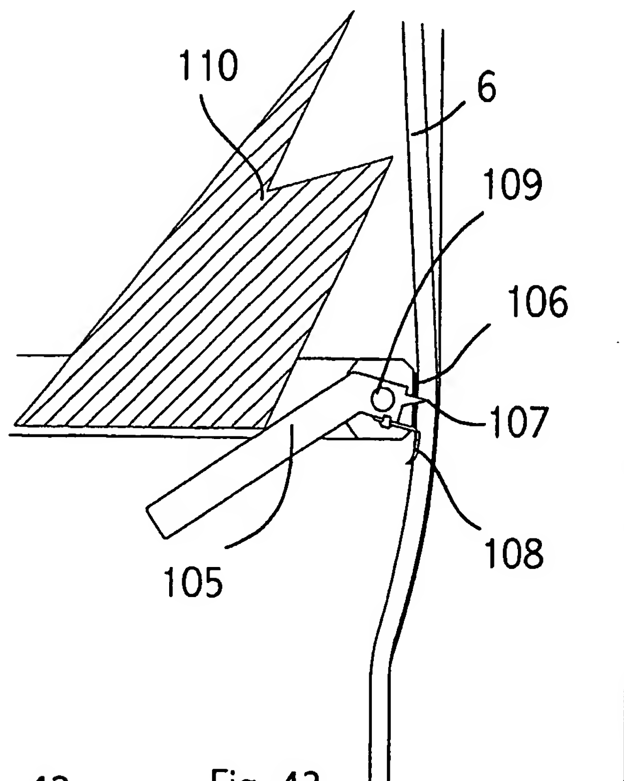

Fig. 43

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 03/02189

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E21B23/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 553 732 A (BAKER HUGHES INC) 4 August 1993 (1993-08-04) column 9, line 22-56 figure 1	15,16
X	US 4 792 802 A (MEADOWS ALAN) 20 December 1988 (1988-12-20) column 3, line 58-67	15,16
X	US 5 105 878 A (FOREST FRANK C ET AL) 21 April 1992 (1992-04-21) the whole document	15
A	US 4 181 184 A (SCHERBATSKOY SERGE A) 1 January 1980 (1980-01-01) figures 3,4	1,18

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
19 August 2003	29/08/2003

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Schouten, A

INTERNATIONAL SEARCH REPORT

Interna   pplication No
PCT/GB 03/02189

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 722 488 A (NORMANN RANDY A ET AL) 3 March 1998 (1998-03-03) the whole document ---	1,15,18
A	US 4 271 908 A (ROBINSON JR LEON H ET AL) 9 June 1981 (1981-06-09) the whole document -----	1,15,18

INTERNATIONAL SEARCH REPORT

Interna[tional A]pplication No
PCT/GB 03/02189

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
EP 0553732	A	04-08-1993	US	5294923 A	15-03-1994
			CA	2088452 A1	01-08-1993
			EP	0553732 A1	04-08-1993
			NO	930324 A	02-08-1993
US 4792802	A	20-12-1988	GB	2190410 A	18-11-1987
			AU	583727 B2	04-05-1989
			AU	7247787 A	19-11-1987
			BE	1000399 A5	22-11-1988
			DE	3714547 A1	19-11-1987
			ZA	8703234 A	29-10-1987
US 5105878	A	21-04-1992	NONE		
US 4181184	A	01-01-1980	NONE		
US 5722488	A	03-03-1998	AT	199274 T	15-03-2001
			AU	719353 B2	04-05-2000
			AU	2668497 A	07-11-1997
			BR	9708728 A	04-01-2000
			CA	2252400 A1	23-10-1997
			DE	69704115 D1	29-03-2001
			DE	69704115 T2	21-06-2001
			EP	0900317 A1	10-03-1999
			WO	9739219 A1	23-10-1997
US 4271908	A	09-06-1981	AU	6665881 A	06-08-1981
			CA	1148851 A1	28-06-1983
			DE	3128160 T0	01-04-1982
			GB	2076876 A	09-12-1981
			NO	813141 A	15-09-1981
			WO	8102181 A1	06-08-1981